

Harmful Algal Blooms (HABs)

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Algae = Phytoplankton

- Microscopic organisms
- Found in marine and freshwater
- Major source of food and oxygen for wildlife
- Several thousand species exist worldwide
- ~70 – 80 species toxin-producing (dinoflagellates or diatoms)
- 16 potential toxin-producing species in VA

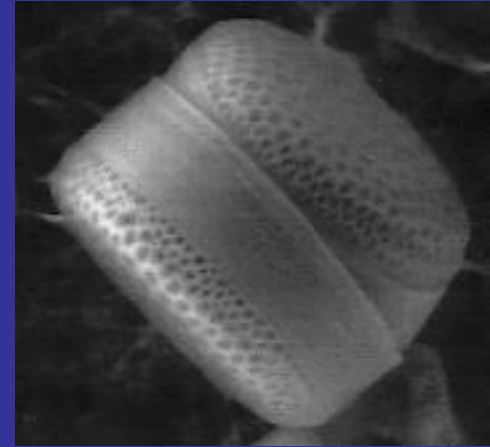
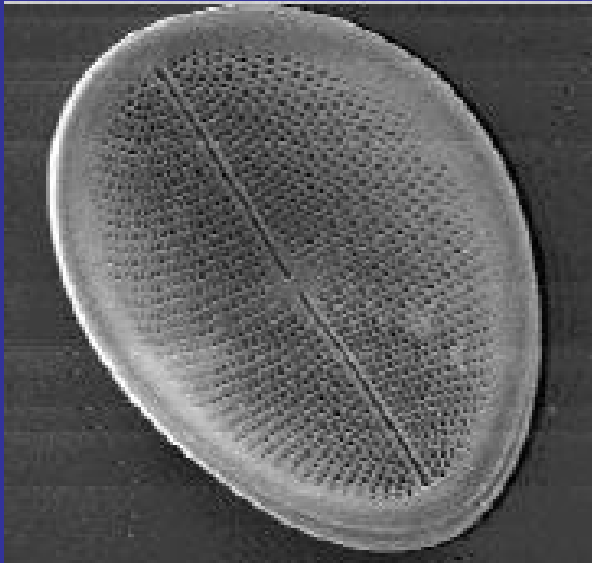
Toxin-producing algae - dinoflagellates and diatoms

- Unicellular, usually low concentration
- Under certain conditions may proliferate (“blooms” or “red tides”)
- May pose environmental, animal, and/or human health threat
- Harmful Algal Blooms (HABs)

Toxin-producing algae – dinoflagellates



Toxin-producing algae – diatoms



California Noctiluca Bloom

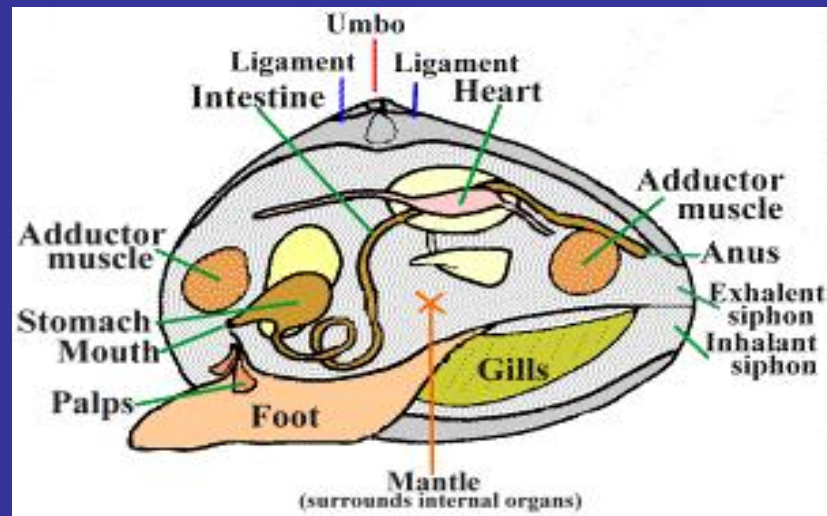


Florida Red Tide Bloom of *Karenia brevis*



Toxins produced by HABs

- Heat stable
- May accumulate in shellfish and finfish
- May cause illness in humans when contaminated shellfish or fish are ingested

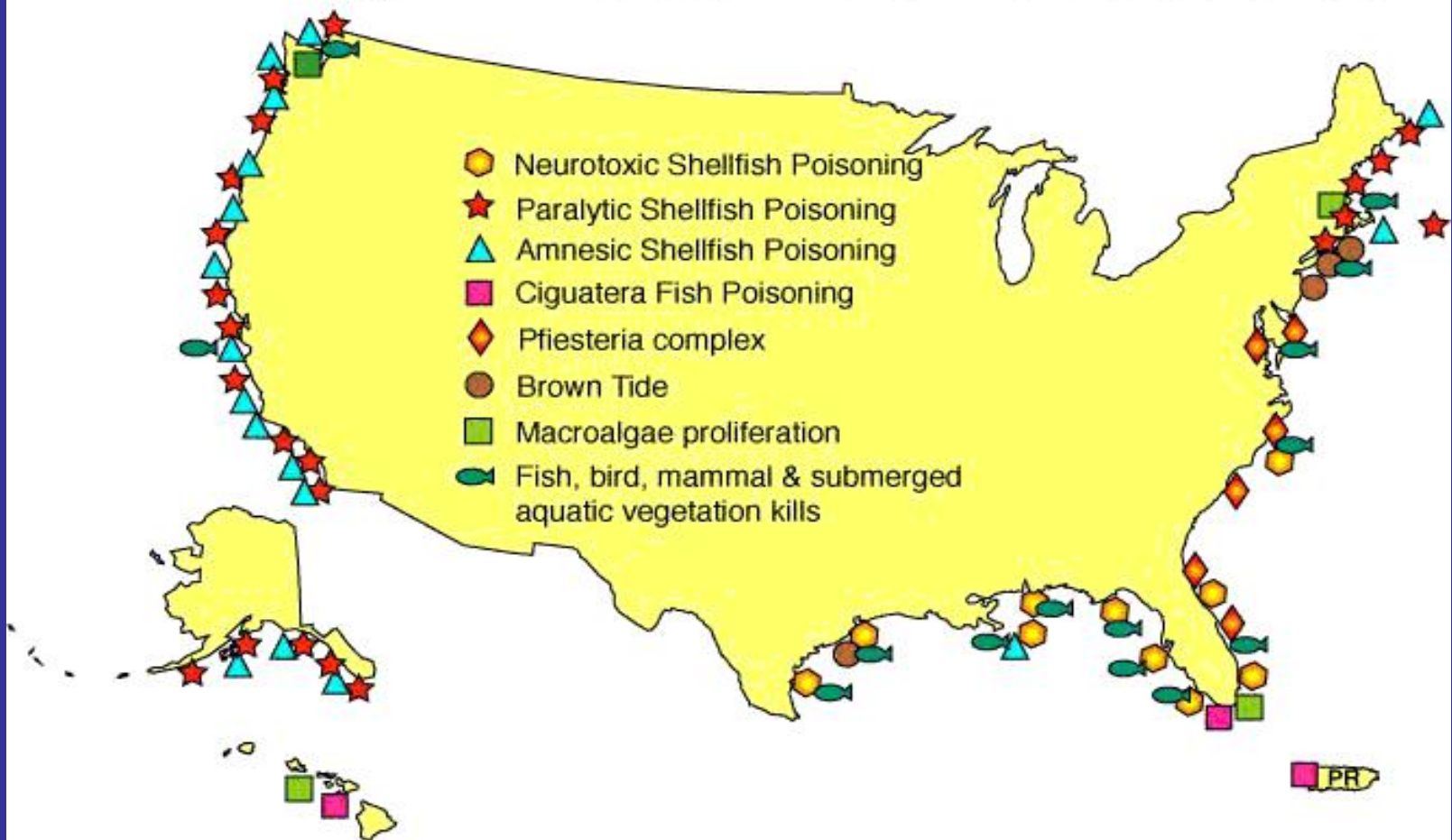


Illnesses caused by HABs

- Paralytic Shellfish Poisoning (PSP)
- Diarrhetic Shellfish Poisoning (DSP)
- Ciguatera Fish Poisoning (CFP)
- Neurotoxic Shellfish Poisoning (NSP)
- Amnesic Shellfish Poisoning (ASP)

HABs geographic distribution, U.S.

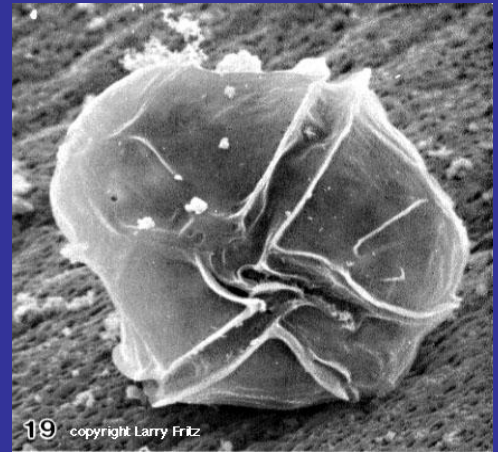
Major HAB-related Events in the Coastal U.S.



Source: NOAA COP/National HAB office-WHOI

Paralytic Shellfish Poisoning (PSP)

- Reported worldwide for centuries
- Globally, ~2000 cases/year
- Mortality rate around 15%
- Dinoflagellate *Alexandrium* spp.
- Toxin = saxitoxin
- Toxin blocks neuronal and muscular sodium channels in peripheral nervous system

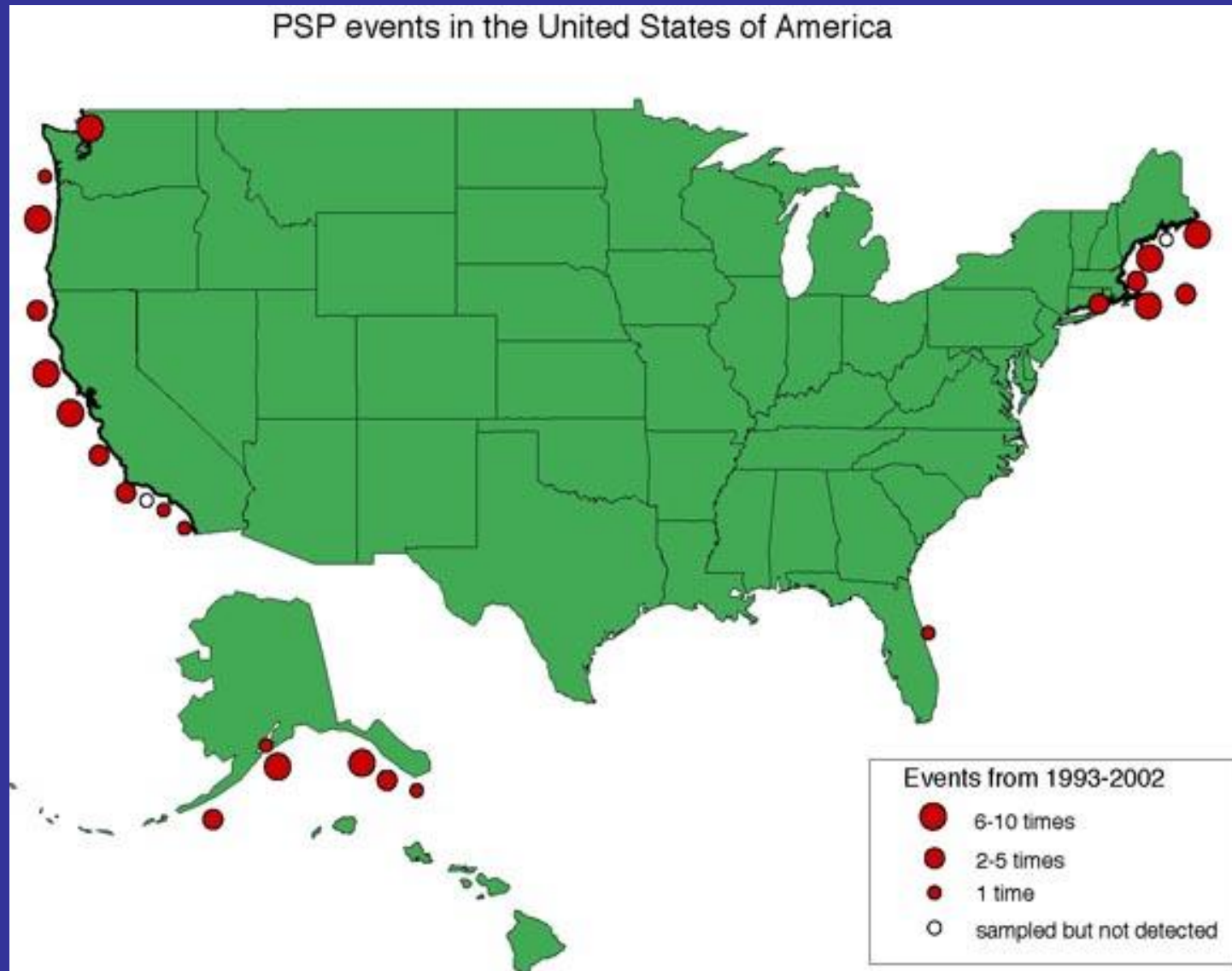


Paralytic Shellfish Poisoning (PSP)

Clinical characteristics

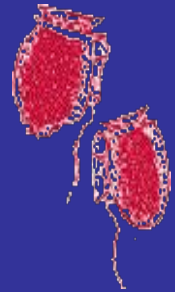
- Onset of illness after ingestion: 5 – 30 min.
- Perioral tingling
- Progression to numbness of face and neck
- Incoordination, nausea, vomiting, headache, swallowing and respiratory difficulty
- Severe cases: respiratory muscle paralysis, death
- Recovery within 12-18 hrs. of onset

PSP geographic distribution, U.S.



Diarrhetic Shellfish Poisoning (DSP)

- First reported in Netherlands in 1960s
- Occurs worldwide, foci Europe and Japan
- No reported cases in U.S. to date
- Dinoflagellate: *Dinophysis* spp.
- Toxin: okadaic acid and derivatives
- Toxin impairs sodium secretion in intestinal cells leading to impaired water balance and fluid loss



Diarrhetic Shellfish Poisoning (DSP)

Clinical characteristics

- Onset of illness after ingestion: 30 min. to 3-12 hrs.
- Comparatively milder illness
- Diarrhea, nausea, vomiting
- Recovery within 3 days of onset
- Okadaic acid possible tumor promoter

Ciguatera Fish Poisoning (CFP)

- Most commonly reported marine toxin disease worldwide
- >50,000 cases/year reported
- Endemic in Caribbean
- Caused by consumption of contaminated reef fish (barracuda, grouper, snapper)

CFP geographic distribution, U.S.

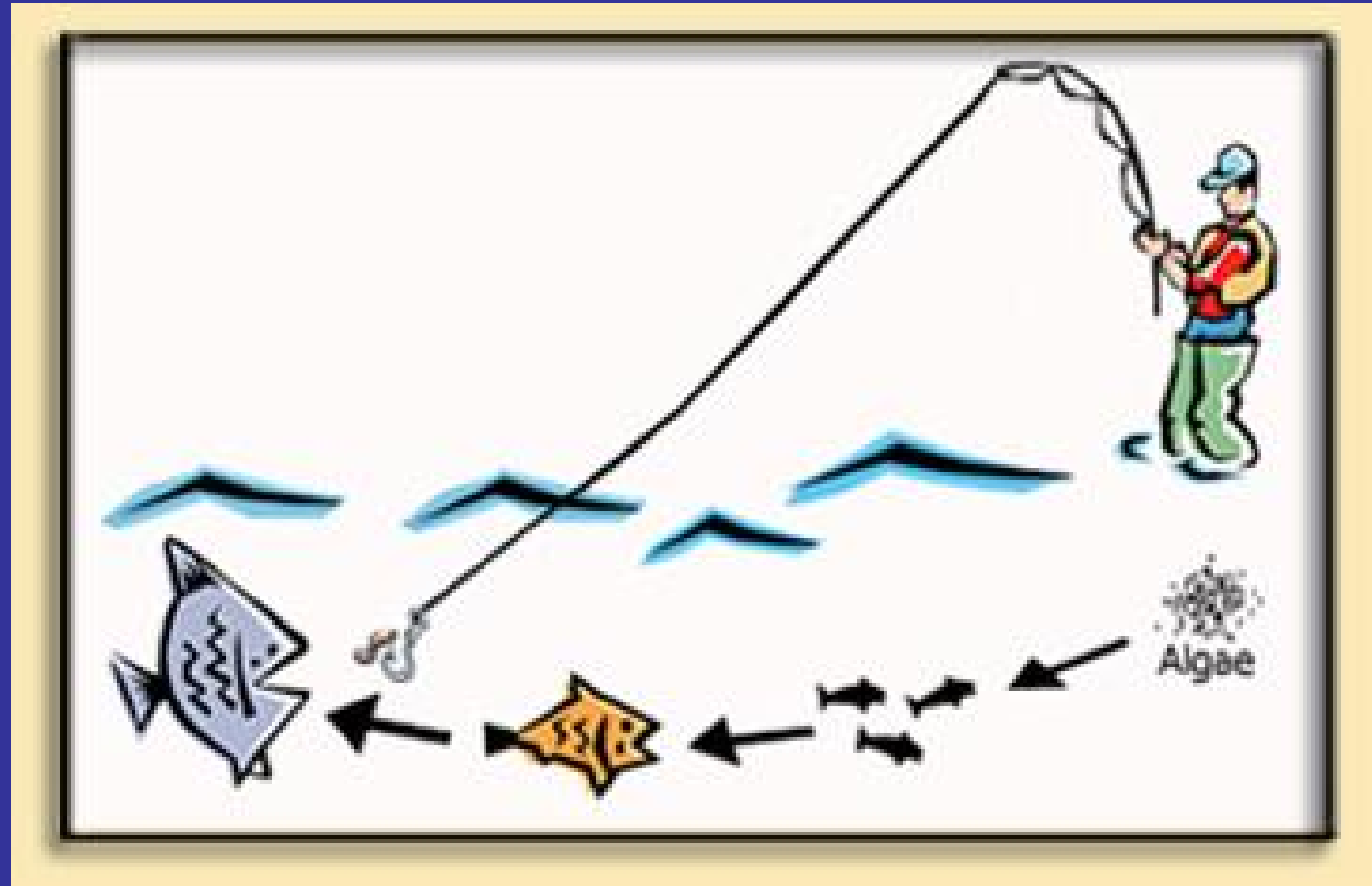


Ciguatera Fish Poisoning (CFP)

- Dinoflagellate: *Gambierdiscus toxicus*
- Toxin: ciguatoxin
- Toxin opens sodium channels in cell membranes inducing membrane depolarization



Ciguatera Fish Poisoning (CFP)



Ciguatera Fish Poisoning (CFP)

Clinical characteristics

- Onset of GI symptoms: ~3 hrs.
- Nausea, vomiting, diarrhea
- Onset of neuro. symptoms: w/in 24-30 hrs.
- Parathesias, blurred vision, headache, itching, arrhythmias, heart block, paralysis
- Reversal of hot and cold temperature sensation
- Rarely, death

Ciguatera Fish Poisoning (CFP)

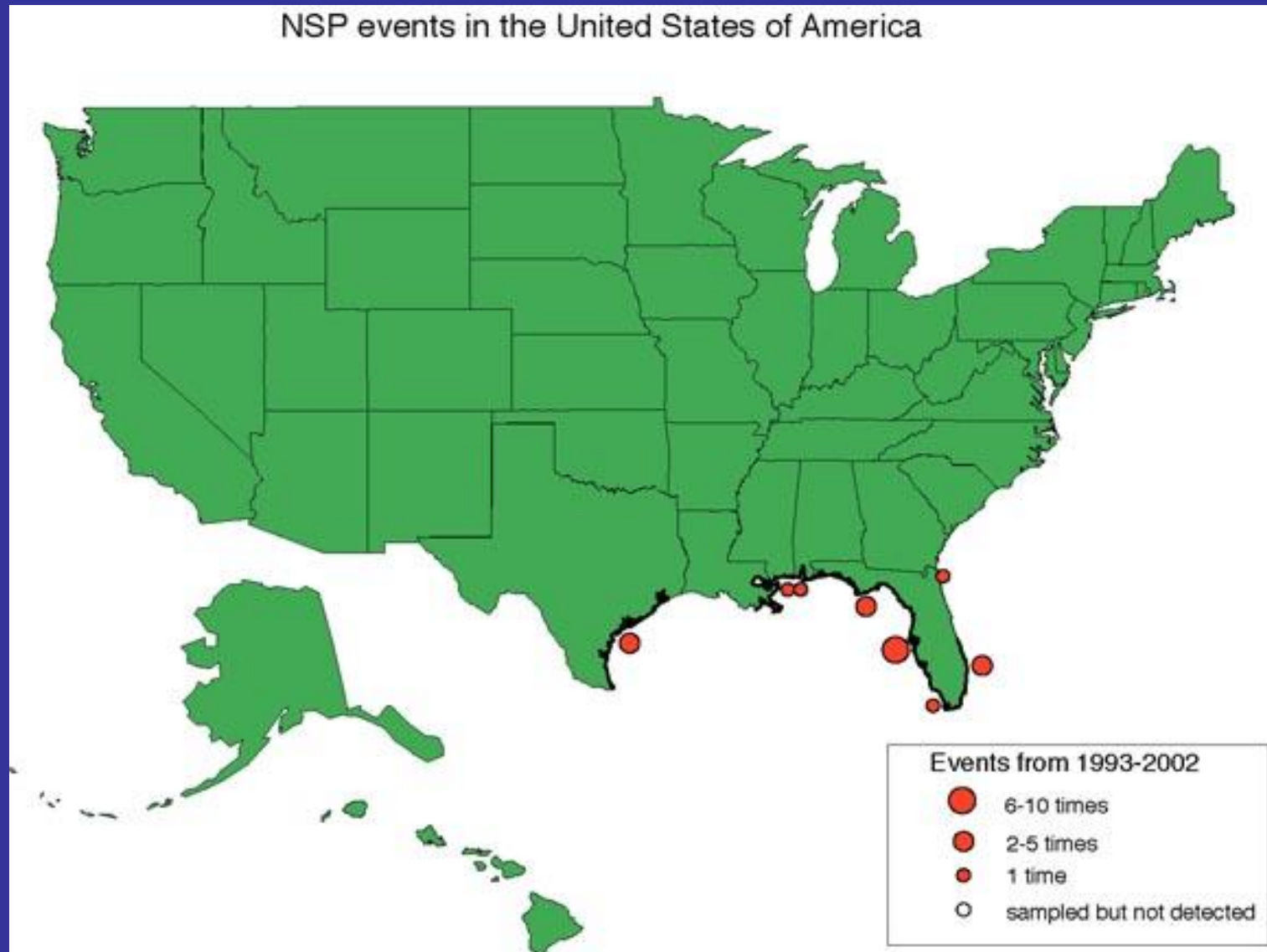
Clinical characteristics

- May vary by geographic region and among individuals with same food source
- Pacific: neurological symptoms
- Caribbean: GI followed by neurological symptoms
- Some cases have chronic symptoms (parathesias, itching, headache, depression, malaise)

Neurotoxic Shellfish Poisoning (NSP)

- First recorded in 1880 on FL west coast
- Historically associated with red tides
- Since 1880 reports from Gulf of Mexico, FL east coast, and NC coast
- 1987 >48 cases reported during NC red tide
- 1990s red tide in Gulf of Mexico caused massive manatee, fish, and bird kills

NSP geographic distribution, U.S.



Neurotoxic Shellfish Poisoning (NSP)

- Dinoflagellate: *Karenia brevis*
- Toxin: brevetoxin
- Toxin binds and opens sodium channels causing persistent sodium influx to cells



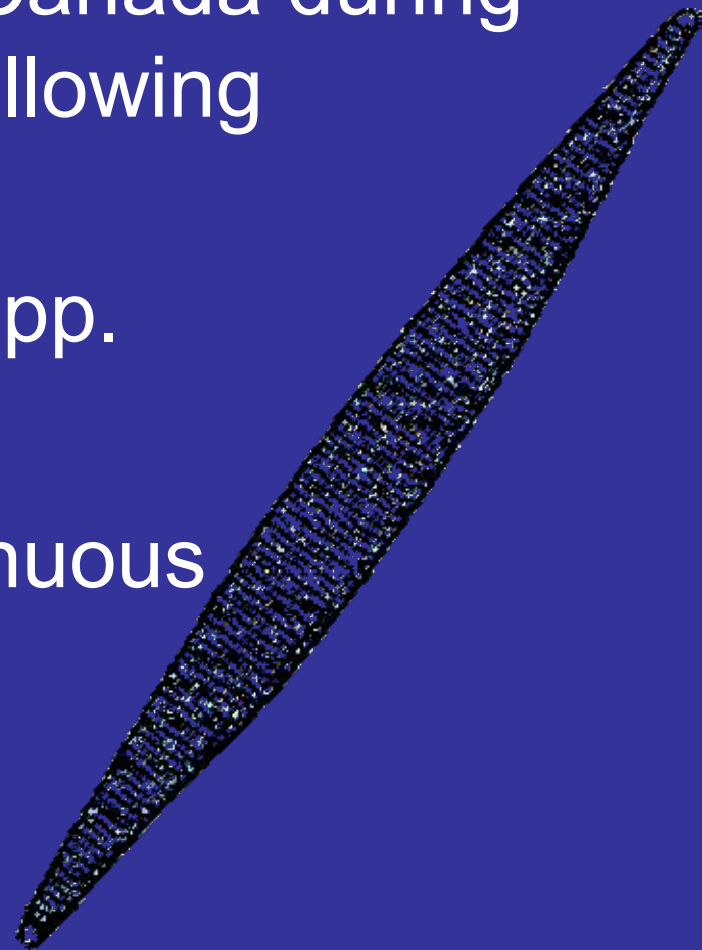
Neurotoxic Shellfish Poisoning (NSP)

Clinical characteristics

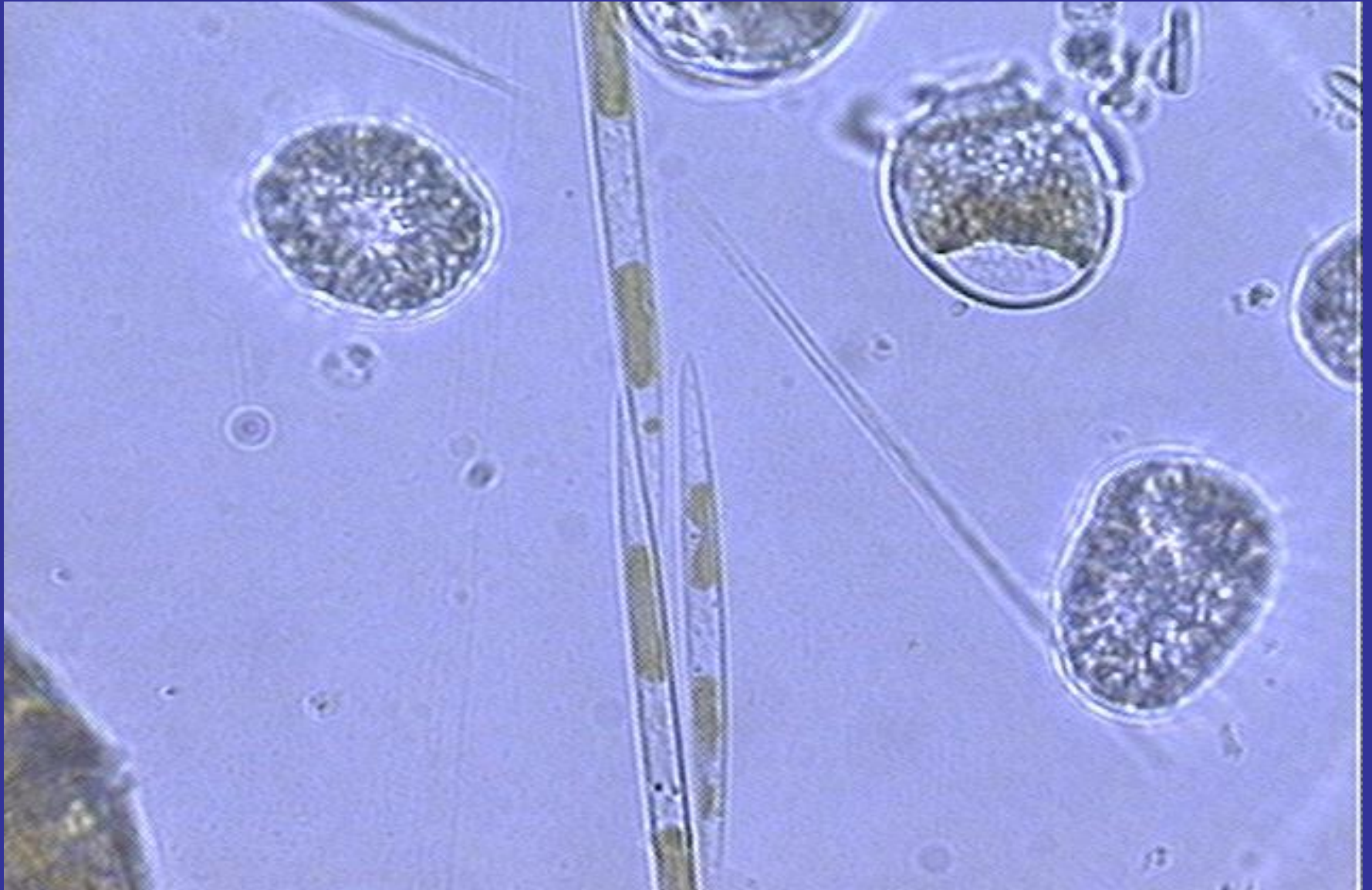
- Similar to PSP (rapid onset, perioral tingling, face and neck numbness, nausea, vomiting, dizziness, swallowing difficulty)
- Unlike PSP, not known to cause death
- Aerosolized toxins may cause respiratory irritation (throat burning, conjunctivitis, nonproductive cough)

Amnesic Shellfish Poisoning (ASP)

- First described in 1987 in Canada during an outbreak of GI illness following ingestion of mussels
- Diatom: *Pseudo-nitzschia* spp.
- Toxin: domoic acid
- Toxin actions lead to continuous stimulation of neurons



Pseudo-nitzschia spp.

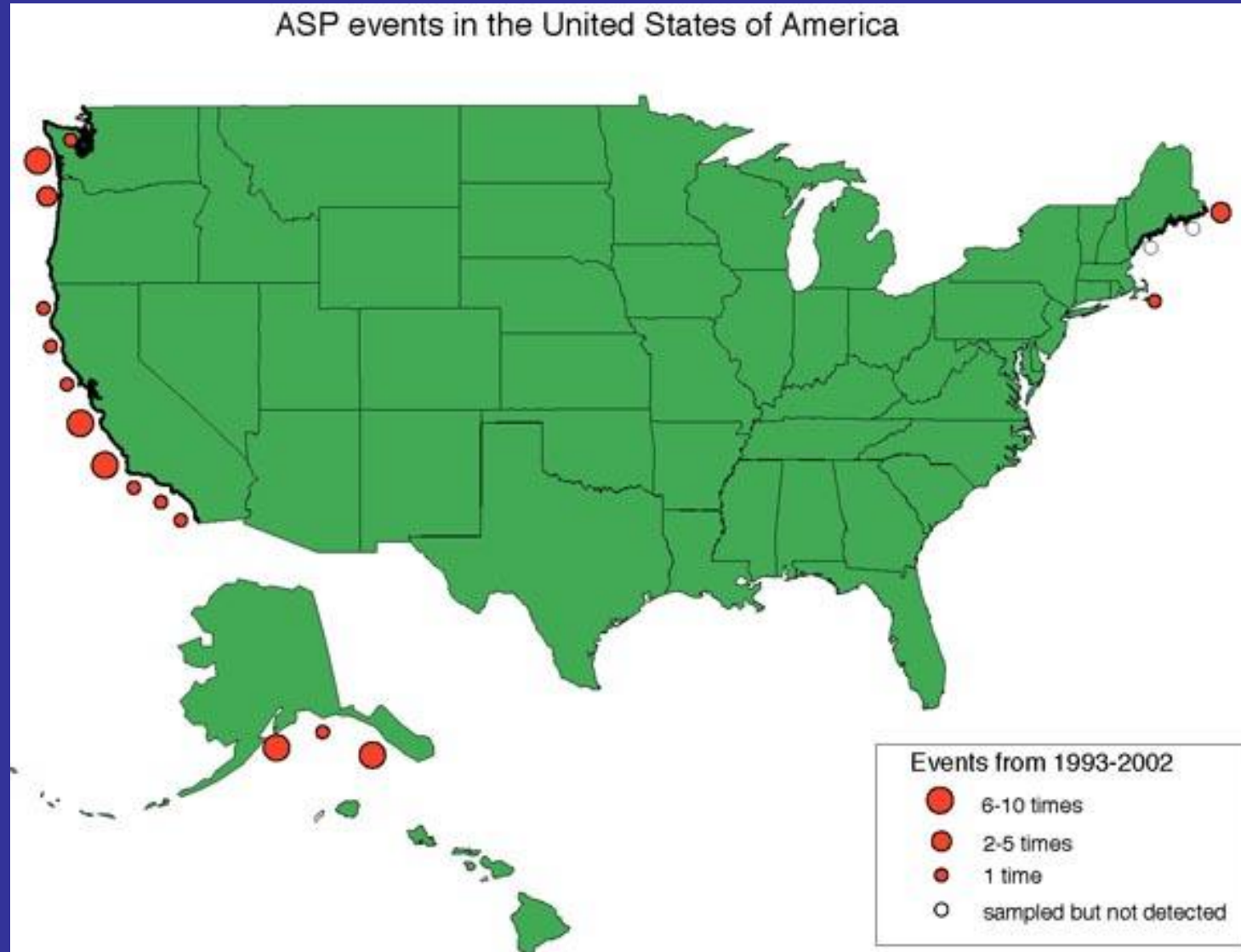


Amnesic Shellfish Poisoning (ASP)

Clinical characteristics

- Onset GI symptoms w/in 24 hrs. of exposure
- Onset neuro. symptoms w/in 48 hrs. of exposure
- GI: nausea, vomiting, diarrhea
- Neuro: confusion, memory loss, seizures, coma, rarely death
- Some instances, permanent short term memory loss

ASP geographic distribution, U.S.



Outbreak of Toxic Encephalopathy Caused by Eating Mussels

*TM Perl, L Bedard, T Kosatsky, JC Hockin,
EC Todd, and RS Remis*

**Bureau regional des maladies infectieuses,
Montreal, PQ, Canada**

N Engl J Med 1990; 322:1775-1780, Jun 21, 1990

Description of Outbreak

- Three people with rapid onset of confusion, disorientation, and memory loss within 24 hours of eating mussels from Prince Edward Island
- Leftover mussels were analyzed for paralytic shellfish toxin (saxitoxin) by mouse bioassay
- Testing resulted in involuntary hind leg scratching in mice, a reaction that is not typical of paralytic shellfish poisoning
- More cases were identified. On December 1, 1987, Health and Welfare Canada issued a warning advising the public to avoid eating mussels from Prince Edward Island



Case definition

- Occurrence of one or more gastrointestinal symptoms: vomiting, diarrhea or abdominal cramps, within 24 hours after consumption of mussels from Prince Edward Island on or after November 1, 1987

OR

- At least one of the following neurologic symptoms or signs within 48 hours after mussel consumption: confusion, loss of memory, disorientation, or other serious signs or symptoms such as seizures or coma
- 250 reports of illness were received in Canada related to consumption of mussels; 107 reports met the case definition

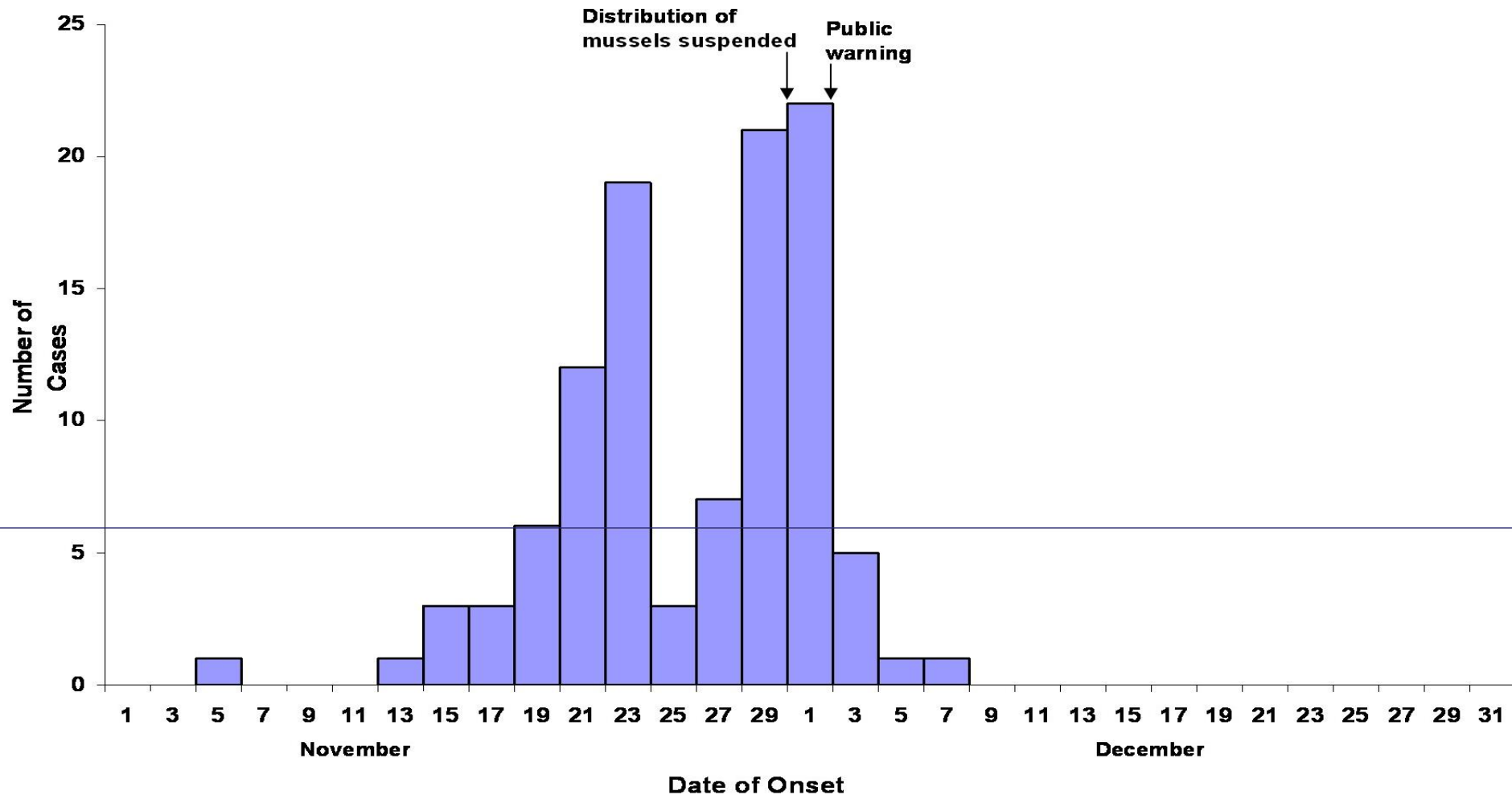
Description of Cases

- Onset of illness ranged from November 4 to December 5, 1987
- Of the number of respondents
 - 60% were men
 - 46% were between 40 and 59 years, 36% were 60 or older
 - 66% were residents of Quebec
- Range of symptoms
 - 77% responses had nausea
 - 76% vomiting
 - 51% abdominal cramps
 - 42% diarrhea
 - 43% headache
 - 25% short-term memory loss

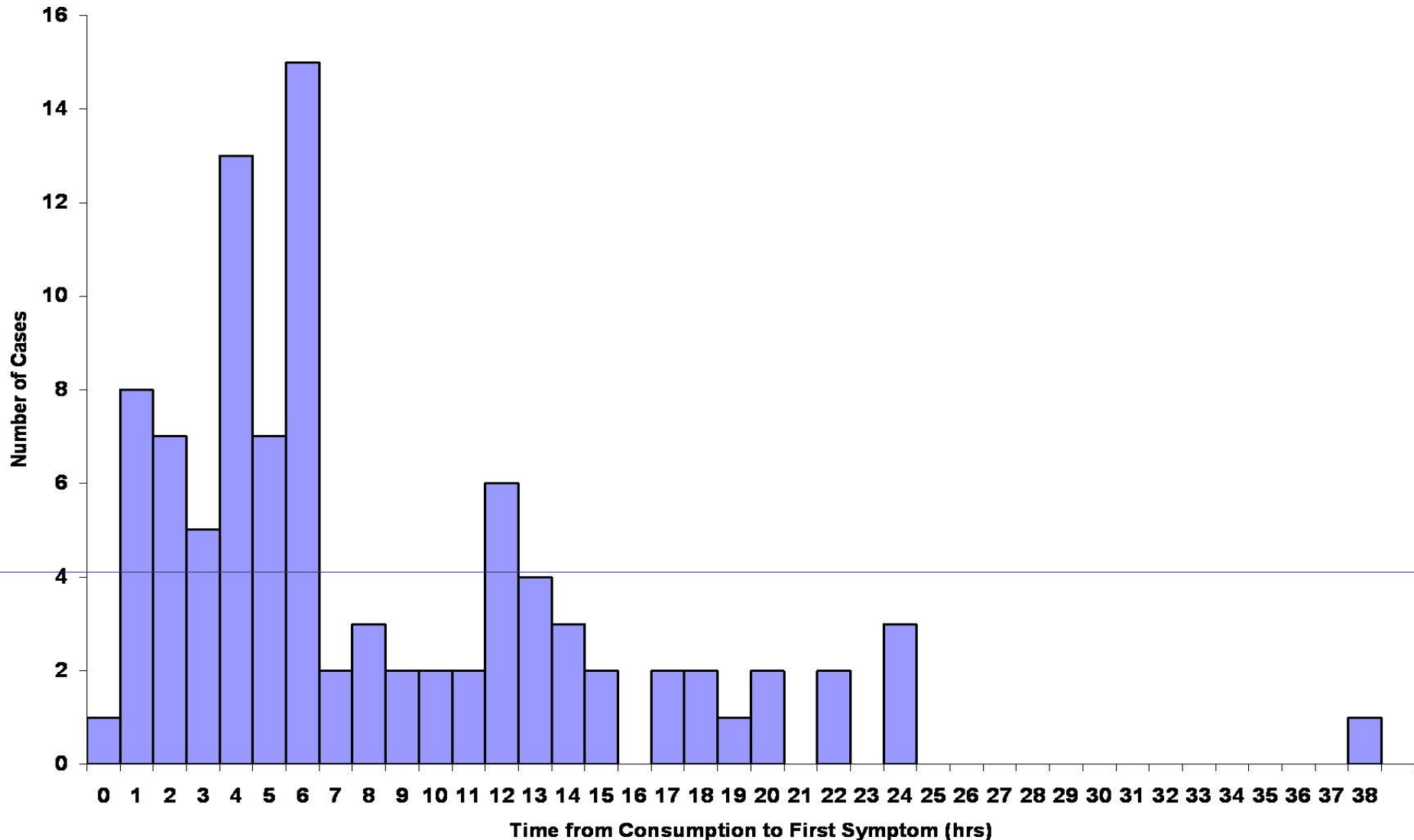
Description of Cases cont'd

- From time to ingestion to onset of first symptoms, ranged from 15 minutes to 38 hours (median, 5.5 hours)
- 18% of patients were hospitalized, usually within two days of onset of symptoms
- Among hospitalized, confusion, disorientation, and inability to recall the recent past
- Three patients, (71, 82, and 84 yrs of age), died in the hospital 12, 24, and 18 days, respectively after eating mussels

Cases of Mussel-Associated Intoxication According to Date of Onset of Symptoms, Canada, November and December 1987



Interval between Mussel Ingestion and the Onset of the First Symptom (Incubation Period)



Discovery of toxin

- No bacterial or viral pathogens, heavy metals, PCBs or pesticides detected
- Standard physical methods for separating complex mixtures applied to poisoned mussel samples
- Mass spectrometry used to determine the compound's molecular weight and formula
- Spectroscopic analysis revealed features of an amino acid
- Domoic acid is similar in structure to glutamic acid
- Domoic acid traced to *Pseudo-nitzschia pungens*

Diagnosis and treatment of HAB-related illness

- Suspect toxic seafood poisoning in those with recent history of seafood ingestion and compatible symptoms
- Identify toxin in seafood (or its source)
- Rule out other causes of illness (*Vibrio cholera*, scombroid fish poisoning, puffer fish poisoning)
- Treatment mainly supportive

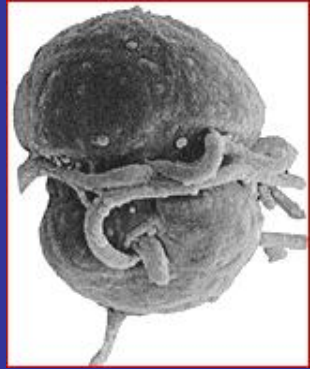
LHD role during HAB or report of HAB-related illness

- Alert medical community and public to look out for symptomatic individuals and to report to LHD
- Notify VDH so they can assist with confirming diagnosis, detecting other cases, identifying source, prevention of further illness, notifying federal and state agencies to institute food trace backs, and arranging water testing
- Conduct active surveillance for cases

Monitoring of Virginia's Marine and Estuarine Waters for HABs

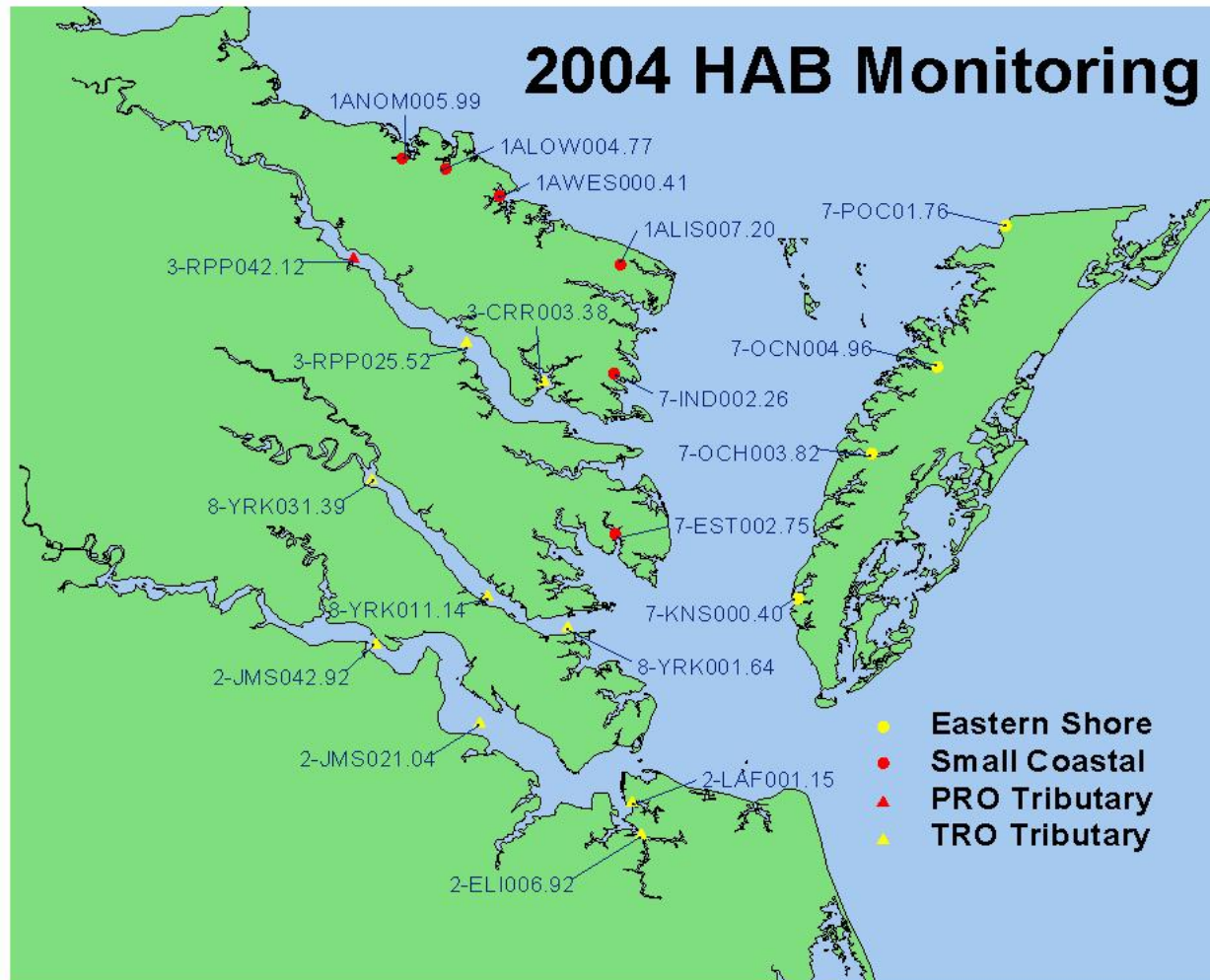
- VA's Department of Shellfish Sanitation in collaboration with FDA routinely monitors shellfish for biotoxins
- ~50 sampling stations in the Chesapeake Bay and tributaries
- Shellfish samples tested at FDA's Southeast Regional Laboratory in Atlanta

Virginia HAB Task Force



- Outgrowth of 1997 occurrence of lesions on finfish and a modest fish kill in Virginia's estuarine waters associated with *Pfiesteria* spp.
- Collaborative effort established to monitor and respond to potential public health effects of *Pfiesteria* spp. and other HABs
- Participants: VDH, VIMS, VDEQ, ODU, VMRC, plus auxiliary and academic institutions
- No human health effects identified since start

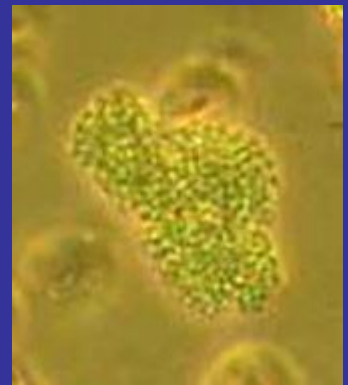
Virginia HAB monitoring sites



Current events

blue-green algae = cyanobacteria

- HAZMAT and VDEM reported bright blue-green paint-like material off Colonial Beach on Potomac on 6/24/04
- Anecdotal reports of children with rashes
- *Microcystis aeruginosa* identified on 6/25/04
- Grows in low salinity and tidal fresh water of Chesapeake Bay
- Colonial Beach closed temporarily





Current events

blue-green algae = cyanobacteria

- Produces variety of toxins with potential to cause illness in animals and humans
- Health effects depend on toxin produced and mode of exposure
- Ingestion: liver and GI symptoms
- Direct contact and inhalation: irritation of skin, eyes, nose, throat, lungs
- Long term: increased risk of liver cancer

Blue-green algal blooms



HABs - Conclusions

- Occurrence of HABs in Virginia's coastal waters is rare
- Increase in HABs worldwide may be due to: climatic changes, anomalous weather events, transport of nonindigenous species, pollution, better detection
- Because of potential for HABs to occur in VA or for toxin-containing seafood to be imported, critical to be aware of human illnesses they cause and persons at risk

Examples of other water-related illnesses

- Scombroid fish poisoning
- Puffer fish poisoning
- Non-tuberculous mycobacteria skin infections
- *Vibrio* spp. skin infections

Toxins from Other Sources: Scombroid Fish Poisoning

- Histamine Poisoning
- Associated Foods:
 - tunas (e.g., skipjack and yellowfin)
 - mahi mahi
 - mackerel
 - abalone
- Symptoms usually occur 1 min - 3 hrs of ingestion
- Symptoms
 - rash
 - diarrhea
 - headache
 - vomiting
 - metallic taste
 - flushing



Toxins from Other Sources:

Puffer Fish Poisoning

- Tetrodotoxins
- Commonly found in Puffer fish in the Pacific around China and Japan
- Toxins are concentrated in the liver, gonad, roe and skin but flesh can also be toxic
- Symptoms include numbness of face and extremities, floating sensation, ascending paralysis, respiratory failure, cardiovascular collapse, death
- Symptoms occur <30 min
- Death may occur in 4-6 hrs



Nontuberculous mycobacteria (NTMs) skin infections

- NTMs present in swimming pools, aquariums, coastal water, or fish
- Skin infections occur when water or fish contacts cuts or abrasions on skin
- “Fish handler’s disease”
- *M. marinum* most common causative organism

Nontuberculous mycobacteria (NTMs) skin infections

- Usually occur on extremities
- Minor infections may heal spontaneously
- Some require antibiotics
- More serious infections may require surgical debridement
- Delay in treatment may prolong infection
- Concern for immunocompromised

Nontuberculous mycobacteria (NTMs) skin infections



Vibrio spp. skin infections

- Naturally occurring “halophilic” species = requires salt water
- May occur when open wounds exposed to seawater
- May lead to skin breakdown and ulceration
- Untreated infection may disseminate, especially in immunocompromised
- Antibiotic treatment required
- *V. vulnificus* causative organism

Vibrio spp. skin infections



VDH response to NTMs and *Vibrio* spp. skin infections

- Tracks number of laboratory tests for each
- Investigates unusual numbers of + tests
- Educates health care workers, people exposed to water that may contain each bacteria about risk for infection and how infection may be prevented
- Encourages medical and public health workers to report cases to VDH

WARNING . . .

TOXIC SHELLFISH

SHELLFISH FROM THIS
AREA ARE UNSAFE TO
EAT DUE TO **PARALYTIC
SHELLFISH TOXIN**.
DO NOT EAT CLAMS,
OYSTERS, MUSSELS OR
SCALLOPS.

Vietnamese LƯU Ý - HẢI SẢN ĐỘC
HẢI SẢN VÙNG NÀY KHÔNG TỬ AN BỮA VI CÓ CHỨA ĐỘC TỐ GÂY
BỆNH TÊ LIẾT - KHÔNG BỤNG ĐAU HỌNG, MÙI - KÈ - ĐÈ.

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Spanish LOS MARISCOS DE ESTA ÁREA SON PELIGROSOS PARA COMER DEBIDO A TÓXICOS
PARALIZANTES. NO COMA TODAS CLASES DE ALMEJAS, OSTRAS, O MEJILLONES.

Red Tide Hotline
1-800-562-5632

TDO RELAY SERVICE
1-800-833-6388
For information call (360) 753-5992



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